Review of Research on Phosphate Fertilizer Management for Turfgrass

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This brief informal review was conducted to outline evidence useful in discussion of a low-P standard for fertilizers intended for use on home lawns.

1. Other jurisdictions

Current fertilizer regulations in Florida use these terms:

"No-phosphate fertilizer" for materials with less than 0.5% P_2O_5

"Low-phosphate fertilizer" for materials which when used at rates in accordance with directions do not exceed 0.25 lb $P_2O_5/1000ft^2$ per application and not to exceed 0.50 lb $P_2O_5/1000ft^2$ per year. (Source: https://www.flrules.org/gateway/RuleNo.asp?ID=5E-1.003)

The Association of American Plant Food Control Officials discussed the following proposed definition in 2006, but does not appear to have yet adopted it:

"Low Phosphate Turf (or Lawn) Fertilizer is a term describing fertilizer products with low phosphate levels (≤5.0%) and having maximum phosphate application rates below normal maintenance levels for turf (as established by the state in which the fertilizer is being sold). (Typically?) the amount of P_2O_5 applied must be < (≤?) 0.15 lb $P_2O_5/1000ft^2$ of turf during a single application."

In a fertilizer product containing 28% N and applied at a rate to supply 1 lb $N/1000ft^2$, the Florida definition would allow a grade as high as 7% P_2O_5 if the material were applied no more than twice per year. It is possible, though not common, for a turfgrass fertilizer to contain even more than 28% N, and thus meet the Florida low-phosphate criterion with even higher analysis. An extreme example: a blend of urea and DAP with analysis of 40-10-0 could possibly be formulated. However, this is uncommon, since it would supply no other nutrients, is not slow- or controlled-release, and risks salt injury or "fertilizer burn."

Since recommendations often call for more than 2 lb $N/1000ft^2$ per year, it is difficult to attain control of P fertilizer rates by controlling the concentration of P in a fertilizer alone. Use of a low P standard may lead to increased use of low-analysis organic sources including manures and composts, which do not necessarily reduce P losses to runoff (Easton and Petrovic, 2004).

In eastern North Carolina, a survey was conducted to evaluate current fertilizer management practices on turf (Osmond and Hardy, 2004). Findings:

"Most household residents (53%) used instructions on the bag and either grass type and/or lawn area to guide them on fertilizer application rates. Grass area or grass type was used by 21% of households to determine fertilizer rate. Eleven percent of the respondents used soil tests to guide their fertilizer application rates."

"Initial soil testing of lawns in Cary found that the majority of the lawns did not need additional P. Without soil testing, homeowners will continue to add unnecessary P fertilizers and may have very low N use efficiency in lawns where fertility is otherwise not optimum."

"Any fertilizer that lands on hard surfaces is subject to direct discharge into surface waters via stormwater systems. Only 52% of homeowners clean impervious surfaces after fertilization. Removing fertilizer inadvertently applied to impervious surfaces would decrease direct fertilizer discharge to surface waters and greatly reduce fertilizer pollution in urban areas."

These results indicate that soil testing for turf can be done but needs promotion, and that education programs on following label directions and proper application are needed.

While amounts of P larger than necessary may sometimes be applied when turfgrass is fertilized, there are also large areas of turfgrass that are never fertilized, and thus potentially nutrient-limited for P. A turfgrass management survey conducted in New York State (NASS, 2004) reported amounts spent by homeowners on fertilizer. The amounts spent indicate that on average, residential lawns are fertilized at rates far below recommended levels for N and P.

2. Changes in soil test P in response to turfgrass P fertilization

In two New York soils, Soldat et al. (2007) found that rates of application of P fertilizer at rates of 0.4 to 1.5 lb P_2O_5/1000ft^3 per year over a period of 4 or 5 years increased soil P in the top 2 inches by a factor of 2.7 to 3.3, but a rate of 0.2 lb P_2O_5/1000ft^3 did not significantly increase soil P.

A survey of soil test levels in New York State indicated that 23% of turfgrass soils were rated low and 18% were rated medium (Bruulsema, 2006). Phosphorus application is recommended for both categories; thus, 41% of New York turfgrass soils could be considered P-limited.

In a three-year study in Quebec soils, Badra et al. (2005) reported that the Mehlich-III soil test P increased by 1 ppm for each 0.12 lb/1000ft^3 of applied P_2O_5. It can be expected that soil test P would also decline by approximately this amount, for an equivalent amount of P removed in clippings, if not replaced by additions of P fertilizer.

Change in soil test P is likely to be influenced by whether the clippings are removed or retained.

3. Estimates of P removal in turfgrass clippings

Removal in clippings varies considerably depending on the vigour of the turfgrass. During the active growing season the following amounts of P may be removed when grass clippings are removed from lawns, golf courses, and sports fields (Duble, 2001):

Species	Removal, lb P_2O_5/1000ft^3 per year
Bermudagrass	0.12
St. Augustine grass, Zoysia grass	0.08
Tall fescue, bluegrass	0.08

In Quebec Kentucky bluegrass, Badra et al. (2005) reported that an average clippings yield was 160 to 180 kg/ha of dry matter, in a management system where clippings occurred 2 to 3 times per week from early May to late September. This clipping was taken to a slightly lower height than the maintenance clipping, but if one assumes 20 such clippings per season, this equates to 3200 to 3600 kg/ha. A typical P concentration in Kentucky bluegrass is 0.27 to 0.40% (Jones et al., 1991). Thus the nutrient removals in this situation could range from 0.4 to 0.7 lb P_2O_5/1000ft^3 per year; considerably higher than the estimates in Duble (2001).

A mixture of 80% Kentucky bluegrass and 20% perennial ryegrass in New York was reported to remove amounts equivalent to 0.9 to 1.2 lb P_2O_5/1000ft^3 in the clippings during the 18-month period from seeding in July 2000 to January 2002 (Easton and Petrovic, 2004).

Clearly, removal of P in turfgrass varies widely. It is difficult to assign a single value as sufficient to replace P removed by clipping.

4. Impact of P fertilization of turfgrass on water quality.

Kauffman and Watschke (2007) reported on P in runoff from creeping bentgrass and perennial ryegrass turfs in Pennsylvania, collecting samples after simulated rainfall. They found that "Phosphate-P concentrations in runoff were equal to or lower than previously reported losses from turfgrass sites and were highest within 24 hours after fertilizer application. The initially high phosphate concentrations were temporary and decreased with time." Shuman (2002) also found that mass and concentration of P in runoff declined dramatically between rainfall occurring 4 and 24 hours after application. These findings points to the importance of timing of application of P-containing fertilizers for turf, to avoid runoff-producing rain or excessive irrigation within one to two days after application.

Easton and Petrovic (2004) compared turfgrass fertilized with three organic and two mineral sources of N and P to unfertilized turfgrass. They concluded: "It is generally accepted that fertilizer is needed for rapid turfgrass establishment and growth. Increased shoot density, infiltration, and reduced sediment and runoff loss support the argument that fertilization ultimately results in less water contamination. While initial concentrations and losses were generally higher from the fertilized treatments, rapid establishment and dense growth obtained with fertilizer application tended to reduce overall losses. In many cases we observed equal or higher overall losses of N and P in runoff and leachate from the unfertilized control, supporting the argument that following establishment fertilization can reduce water contamination from N and P."

In another article (Easton and Petrovic, 2005) they stated: "During the first 5 months after seeding, losses of P in run-off were proportional to the amount applied in fertilizer, and nitrate losses were greatest where the most soluble N source (urea) was applied. Following the establishment period, nitrate losses decreased dramatically. The 25 run-off events in 2001 caused less total run-off loss of nitrate than the eight events of 2000, and the fertilized treatments did not differ from the control. However, P losses in run-off from the control plot increased and exceeded those from all fertilized plots." "Turfgrass is an effective filter, slowing run-off and cutting sediment loss. Fertilizing it appropriately can reduce losses of nutrients in run-off."

Kussow (2004) stated: "Simply eliminating phosphorus (P) in lawn fertilizers will not guarantee less P in runoff water. A Wisconsin study found that a major portion of the P in runoff may also originate from the turfgrass itself. Properly maintained lawns have much lower P losses than poorly maintained lawns."

5. Low P standard – concentration, ratio or application rate?

In considering the adoption of a low P standard as a means for ensuring appropriate P nutrition of turfgrass, it should be pointed out that a concentration standard on its own may tend to encourage the application of low-analysis sources, which include organics and composts. When application rates of these materials are high, losses of P in runoff can exceed those from inorganic sources (Easton and Petrovic, 2004, 2005).

For this reason, a low P standard should likely include consideration of recommended application rates (as in the Florida example above) or ratios of P to N in the fertilizer.

While it may be difficult to define a precise value for a low P standard, it is likely that a reasonable number can be chosen that would facilitate appropriate fertilization of turfgrasses with the N and K required for a vigorous stand without excessive buildup of P in the soil.

References

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